ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 4 No. 5 September 2013 Academic Research International

INFLUENCE OF MOISTURE CONTENT ON THE YIELD OF MECHANICALLY EXPRESSED NEEM SEED KERNEL OIL

B. A. Orhevba[1], O. Chukwu[2], Z. D. Osunde[3], V. Ogwuagwu[4]

[1-3] Department of Agricultural and Bioresources Engineering,
[4]Department of Mechanical Engineering,
Federal University of Technology, Minna, Niger State,
NIGERIA.

[1] borhevba@yahoo.com

ABSTRACT

The effect of moisture content on yield of mechanically expressed neem seed kernel oil was investigated. Matured neem seed kernels were obtained and the initial moisture content determined. The initial oil yield in the samples was determined (37.71%) using solvent extraction method. The neem seed kernels were then preconditioned to the following moisture content values: 6.3, 8.1, 13.2 and 16.6 % (wet basis), based on reported values for oil seeds meant for oil extraction; the seed kernels were then subjected to oil extraction using an oil expeller. The recorded oil yield was compared with the initial oil content of the seed kernels. The following oil yield values were obtained at the different moisture content levels: 22.37% (at 6.3% moisture content), 24.86% (at 8.1% moisture content), 21.21% (13.2% moisture content) and 15.62% (at 16.6% moisture content). New Duncan's Multiple Range Test (DMRT) was used to determine the differences in the mean treatment effect of moisture content on oil yield.

Keywords: Moisture content, oil yield, neem seed kernel, solvent extraction, wet basis

INTRODUCTION

Neem (*Azadirachta indica*) tree is native to tropical South East Asia and is a member of the Mahogany family, *Meliaceae* (ICIPE, 1995; Okonkwo, 2004). The neem tree is popularly known as *dongoyaro* in the Northern part of Nigeria where it grows in abundance. All parts of the tree have been reported to be very useful (Adewoye and Ogunleye, 2012). They also reported that the most famous part of the tree is the oil obtained from the seed kernel. Neem seed is a part of the neem tree which has high concentration of oil (Ikasari and Indraswati, 2008). Ahmed and Grainge (1985) also reported that neem seed contains 35-45% oil. The quality of the oil differs according to the method of processing. Neem oil is a vegetable oil expressed from the fruits and seeds of neem plant, an evergreen tree which has found its use widely in different regions of the globe for medicinal and agricultural purposes (Kovo, 2006; Ranajit *et al*., 2002; Awad and Shinamaila, 2003; . Muñoz-Valenzuela *et al*., 2007; Kumar *et al.,* 2010). Neem oil is widely used as insecticides, lubricant, drugs for variety of diseases such as diabetes and tuberculosis (Johnson *et al*., 1996; Ragasa *et al.,* 1997; Puri, 1999). This oil could also prolong leather goods when it is applied on them (Puri, 1999). Peter (2000) reported the uses of neem seed oil to include the following: soap production, raw material for pesticides and cosmetics, plant protection, stock and textile protection, lubrication oil for engines, lamp oil, candle production and refining to edible oil. Kovo (2006) reported its use as an insect repellant and pesticide.

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 4 No. 5 September 2013

MATERIALS AND METHODS

Mature and healthy neem seeds used for the experiments were obtained from Katsina Zonal Forest Office, Ministry of Agriculture and Natural Resources, Katsina State, Nigeria. The seed kernels still within their endocarp were sun dried for some days to allow for their easy removal. The dried endocarp was cracked to obtain the seed kernels; after decortications, the hulls of the kernels and other dirt were removed by winnowing. An oil expeller was used in carrying out oil expression.

Moisture Content Determination

The moisture content of the seed kernel was determined using ASAE 1998 standard for oil seed. Three samples each weighing 15g were placed in an oven set at 105^{0}C for 24hours.The samples were then cooled, weighed and the moisture content calculated. Loss in weight is assumed to be moisture loss. Initial moisture content of the seeds was 8.1%. The sample was divided into four parts; one part (one-fourth) was left as it was; while the remaining part was sun dried at 34^{0}C for 12 hours to further reduce the moisture content to 6.3%. This sample was further divided into three parts, one part (one-third) was left as it was; while the remaining part was further conditioned to desired moisture content levels as described by Akinoso (2006). Adding distilled water as calculated from equation 3.1 increased the moisture content of the seed kernels.

$$Q = \frac{A(b-a)}{(100-b)} \qquad \text{(Akinoso, 2006)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where:

A = Initial mass of the sample

a = Initial moisture content of the sample, % wb

b = Final (desired) moisture content of sample % wb

Q = Mass of water to be added kg

Each sample was sealed in a separate polythene film. The samples were kept at 5^{0}C in a refrigerator for a week to enable the moisture to distribute uniformly throughout the samples. The four moisture content levels that were prepared are: 6.3% wb, 8.1% wb, 13.2% wb and 16.6% wb.

The oil was expressed using a National Cereals Research Institute (NCRI), Badeggi, Niger State, Nigeria developed oil seed expeller. The expeller capacity ranged from 15-20 kg/h and was powered by a 7.5kW, 3 phase electric motor with in-built reduction gear. It was run at 75 rpm.

The experimental procedure was by running the screw press for about 3 minutes before loading the pre-treated samples as described by Akinoso (2006). Experiments were conducted at moisture contents of 6.3, 8.1, 13.2 and 16.6% wb. Oil Expressed and cakes from the samples were collected separately. Cleaning of the expeller barrel was done after each expression. Three replicates of the experiments were done.

The expressed oil was collected and left to stand for 96 hours as recommended by Olajide (2000) and the volume measured. The weights of the cakes were determined by use of an electronic weighing balance. The recorded oil yield was compared with the initial oil content of the seed.

Soxhlet oil extraction method as reported by Akinoso *et al.;* (2000) was applied to determine the initial oil content of the seed. The mean value of three samples was expressed as percentage content as follows:

$$\% \, Oil \, Content = \frac{Weight \, of \, oil \, in \, Solution}{Weight \, of \, seed \, samples} \times 100 \; \ldots\ldots\ldots\ldots\ldots (2)$$

The weights of the oils expressed were obtained by use of a weighing balance. Percentage oil yield and Expression efficiency were calculated as follows:

$$\% \, Oil \, Yield = \frac{Weight \, of \, oil}{Weight \, of \, expressed \, seed} \times 100 \; \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$\% \, Expression \, Efficiency = \frac{Oil \, Yield}{Total \, Oil \, Content} \times 100 \; \ldots\ldots. (4)$$

RESULTS

Effect of Moisture Content on Oil Yield

The results obtained were subjected to the New Duncan's Multiple Range Test (DMRT) to determine the differences in the mean treatment effect of moisture content on oil yield (Table 1).

Table 1. New Duncan Multiple Range Test for Oil Yield at various moisture contents

Moisture Content	Oil Yield
16.6	15.62a
13.2	21.21b
6.3	22.37c
8.1	24.86d

Means with the same alphabet are not significantly different from each other

The result showed that seed kernels with higher moisture content yielded less oil as compared to those with lower moisture content; this agrees with the findings by Farsie and Singh (1985) who reported maximum oil recovery for sunflower seeds expressed at 6% moisture content, they reported further that increasing the moisture content to 14% decreased the oil recovery by 16%. However, from the table, it can be observed that moisture contents at each level recorded significantly different oil yield. The maximum oil yield of 24.86% was observed at 8.1% while the minimum oil yield of 15.62% was recorded at the highest moisture content.

Figure 1 shows the graphical illustration of the effect of moisture content on oil yield.

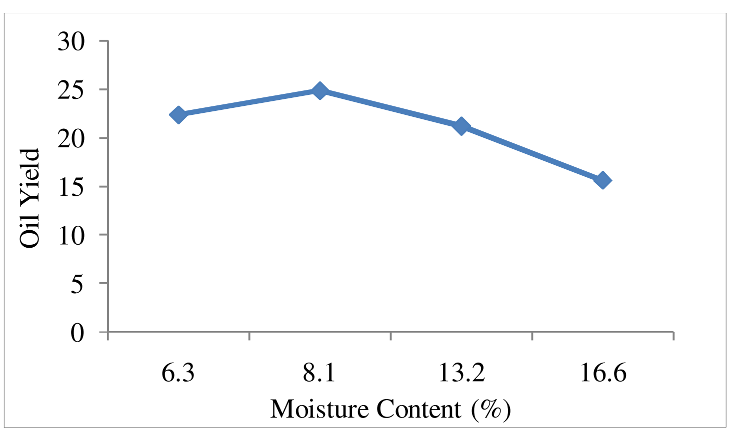

Figure 1. Effect of moisture content on Oil Yield

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 4 No. 5 September 2013

The optimum moisture content falls between 6.3 and 8.1%. Figure 1 show that increasing moisture content of the seed beyond 8.1% led to lower oil yield. This implies that higher moisture content means lower oil yield as far as this experiment and the oil bearing seed under investigation is concerned. Southwell *et al*., (1990) reported that a moisture content of 9% was found to be optimum for expression of oil from avocado fruit. Blake (1982); Sivala *et al*., (1991) reported that moisture content in excess of 9% for canola seed adversely affected the oil yield while 10% and 11% moisture contents gave the maximum oil recovery for unseived rice bran and sieved rice bran respectively. Bongiwar *et al*., (1977) also reported that as the moisture content of groundnut increased up to 6%, the percentage of oil removed increased, but above 6% moisture, the yield decreased. Other researchers, Sivakumaran *et al.,* (1985) and Pominski *et al*., (1970) have also identified an optimum moisture content in the region of 6% for processing of groundnuts for oil. Akinoso (2006) reported that moisture content has highest influence on sesame oil yield; he added that to increase oil yield, moisture content has to be reduced. Young *et al*., (1982) and Tunde-Akintunde (2000) used mathematical models to predict oil expression from sesame seed and soya bean respectively; they also found that moisture content had the greatest influence on oil yield. Ferchau (2000); Owolarafe *et al*., (2003) and Ogunsina *et al.,* (2008) all reported that moisture content most suitable for screw press are commonly within 7-8%.

CONCLUSION

The results showed that seed kernels with higher moisture content yielded less oil as compared to those with lower moisture contents, these results agree with earlier results obtained from researches conducted on similar seeds.

REFERENCES

Adewoye, T. L. & Ogunleye, O. O. (2012). Optimization of Neem Seed Oil ExtractionProcess Using Response Surface Methodology. *Journal of Natural Sciences Research, 2*(6), 66-76.

Ahmed, S. & Grainge, M. (1985). The Use of Indigenous Plant Resources in Rural Development: Potential of the Neem Tree. *International Journal of Development Technology, 3*, 123-130.

Akinoso, R. (2006). Effects of Moisture Content, Roasting Duration and Temperature on Oil Yield and Quality of Palm Kernel (*Elaeis guineensis*) and Sesame (*Sesamium indicum*) Oils. Ph.D Thesis, Department of Agricultural and Environmental Engineering, University of Ibadan, Ibadan, Nigeria.

Akinoso, R., Igbeka, J. C., Olayanju, T. & Bankole, L. (2006). Modeling of Oil Expression from Palm Kernel (*Elaeis guineensis* Jacq.). *Agricultural Engineering International:CIGR Ejournal*, 8, 1- 7.

ASAE. (1998). *Method of Determining and Expressing the Fineness of Feed Materials by Sieving, ASAE S319.3*. American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph MI 49085-9659, Michigan, United States of America. 1998.

Awad, O. M. & Shimaila, A. (2003). Operational Use of Neem Oil as an Alternative Anopheline Larvicide. Part A: Laboratory and Field Efficacy. *Eastern Mediterranean Health Journal, 9*(4), 637-645.

Blake, J. A. (1982). Evaluation of an On-farm Press. In: Vegetable Oil Fuels. *ASAE Publication* No. 482, St. Joseph, MI 49055. pp. 247 –251.

Bongiwar, D. R., Pordwal-Desai, S. R. & Sreenivasan, A. (1977). Studies on the Defatting of Peanuts and Soybeans for Ready–to-eat Snack Items. *Indian Food Packer, 31*(3), 61–76.

Farsie, A. and Singh, M. S. (1985). Energy Models for Sunflower Oil Expression. *Transactions of the American Society of Agricultural Engineers,* 28, 275 –279.

Ferchau, E. Equipment for Decentralized Cold Pressing of Oil Seeds. Folkcenter for Renewable Energy. Retrieved on April 19, 2013, from http://www.folkcenter.dk

Ikasari, M. & Indraswati, N. A. (2008). *Physical Properties of Foods and Processing Systems*. Chichester: Ellis Harwood

International Center of Insect Physiology and Ecology (ICIPE). (1995). *The neem tree:* An Affordable, Efficient and Environmentally-Friendly Source of Pest Control Products. International Center of Insect Physiology and Ecology. Nairobi, Kenya.

Johnson, S., Morgan, E. D. & Peiris, C. N. (1996). Development of the Major Triterpenoids And Oil in the Fruit and Seeds of Neem (*Azadirachta indica*). *Journal of Annals Botany, 78*, 383-388.

Kovo, A. S. (2006). Application of Full 4^2 Factorial Design for the Development and Characterization of Insecticidal Soap from Neem Oil. *Leonardo Electronic Journal of Practices and Technologies, 8*(1), 29-40.

Kumar, S., Suresh, P. K., Vijayababu, M. R., Arunkumar, A. & Arunakaran, J. (2006). Anticancer Effects of Ethanolic Neem Leaf Extract on Prostate Cancer Cell Line (PC-3). *Journal of Ethnopharmacology, 105*(1-2), 246-50.

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 4 No. 5 September 2013

Munoz-Valenzuela, S., Ibarra-Lopez, A. A., Rubio-Silva, L. M., Valdez-Davilla, H. & Borboa-Flores, J. (2007). Neem Tree Morphology and Oil Content. Reprinted from *Issues in newcrops and New uses*. Janick J. and Whipkey A. (eds.) Alexandria, VA: ASHS Press. pp.126.

Ogunsina, B. S., Koya, O. A. & Adeosun, O. O. (2008). Deformation and Fracture of Dika Nut (*Irvingia gabonensis*) under Uni-axial Compressive Loading. *International Agrophysics, 22*, 249-253.

Okonkwo, E. M. (2004). Employment Creation and Opportunities in Manufacturing Sub-Sectors:A Case for Neem Tree in Nigeria. *Bullion Publication of Central Bank of Nigeria, 28*(3), 30-35.

Olajide, J. O. (2000). *Process Optimisation and Modelling of Oil Expression from Groundnut and Sheanut Kernel*. Ph.D Thesis, University of Ibadan, Nigeria.

Owolarafe, O. K., Adegunloye, A. T. & Ajibola, O. O. (2003). Effects of Processing Condition on Oil Point Pressure of Locust Bean. *Journal of Food Processing Engineering, 26*(51), 489-497.

Peter, F. (2000). *Global Neem usage.* Deutsche Gesellschaft fdür Technische Zusammenarbeit (GTZ) GmbH Eschborn, Germany.

Pominski, J., Pearce, H. M. & Spadero, J. J. (1970). Partially Defatted Peanuts –Factors affecting Oil Removal during Pressing. *Food Technology, 24*(6), 92–94.

Puri, H. S. (1999). *Neem: The Divine Tree* (pp. 9-23.). Singapore: Harwood Academic Publishers.

Ragasa, C. Y., Nacpil, Z. D., Natividad, G. M., Tada, M., Coll, J. C. & Rideout J. A. (1997). Tetranortriterpenoids from Azadirachta Indica. *Journal of Phytochemistry, 46*, 555-558.

Ranajit, K. B., Kausik, B., Ishita, C. & Uday B. (2002). Biological activities and medicinal Properties of neem (Azadirachta Indical). *Current Science, 82*(11), 1036 -1045.

Sivakumaran, K., Goodrum, J. W. & Bradley, R. A. (1985). Expeller Optimization of Peanut Oil Production. *Transactions of the American Society of Agricultural Engineers*, 316-320.

Sivala, K., Bhole, N. G. & Mukherjee, R. K. (1991). Effect of Moisture on Rice Bran Oil Expression. *Journal of Agricultural Engineering Research, 50*, 81–91.

Southwell, K. H., Harris, R. V. & Swetman, A. A. (1990). Extraction and Refining of Oil obtained from Dried Avocado Fruit using a Small Expeller. *Tropical Science,* 30, 121–131.

Tunde-Akintunde, T. Y., Akintunde, B. O. & Igbeka, J. C. (2001). Effect of Processing Factors on Yield and Quality of Mechanically Expressed Soybeans Oil. *Journal of Agricultural Engineering Technology, 55*, 86-92.

Young, J. N., Whitaker, T. R., Blankershy, P. O., Brusenitz, G. H., Troeger, J. M. & Person, N. K. (1982). Effect of Oven Drying Time on Peanut Moisture Determination. *Transactions of the American Society of Agricultural Engineers, 25*(2), 491-496.